

IN THE CLAIMS:

Please amend the claims to read as follows:

1. (currently amended) A device for optically measuring qualities of a substance in ambient light comprising:

at least one translucent wall defining a sample chamber for receiving therein the substance to be measured and defining an axis;

a first channel defining a first meridional plane and including thereon:

at least one first radiation source mounted adjacent to the sample chamber, wherein the at least one radiation source includes a first radiation source and a second radiation source, the first radiation source and the second radiation source being axially spaced relative to each other, the first radiation source emits a modulated beam of radiation distinguishable from the ambient light based on said modulation and the second radiation source emits a modulated beam of radiation distinguishable from the ambient light based on said modulation; and

at least one first detector angularly spaced about the axis of the sample chamber relative to the first and second radiation sources, wherein the first at least one detector includes a first detector, the first radiation source is positioned so that a principle ray emitting therefrom substantially passes onto the first detector, the second radiation source is positioned so that a principle ray emitting therefrom substantially passes onto the first detector, the first detector receives the modulated beams of radiation after passage through the sample chamber and substance to be measured therein, and generates a modulated output signal indicative of the intensity of the radiation of the beams impinging thereon;

a second channel defining a second meridional plane and including thereon at least one second radiation source mounted adjacent to the sample chamber, wherein the at least one second radiation source of the second channel includes a third radiation source that emits a second modulated beam of radiation distinguishable from the ambient light and the modulated beam of the first radiation source based on said modulation;

a controller coupled to the first radiation source and the first detector for activating the source and processing the output signal; and

a display coupled to the controller for displaying measurement readings based on the output signals.

2. (original) A device as recited in Claim 1, further comprising a housing defining a recess, and wherein the at least one translucent wall is formed by a vial defining the sample chamber therein, and the first radiation source and first detector are mounted adjacent to the recess.

3. (original) A device as recited in Claim 1, wherein the at least one translucent wall is approximately cylindrical.

4. (currently amended) A device as recited in Claim 1, further comprising at least one oscillator coupled to the at least one ~~first~~ radiation source of the first channel for modulating the at least one radiation source of the first channel.

5. (original) A device as recited in Claim 1, further comprising at least one amplifier coupled to the first detector for boosting the output signal and dampening other frequencies.

6. (currently amended) A device as recited in Claim 1, wherein said at least one ~~second~~ radiation source of the second channel is angularly spaced about the axis of the chamber relative to the first radiation source.

7. (currently amended) A device as recited in Claim 6, the second channel further comprising:

at least one ~~second~~ detector angularly spaced about the axis of the sample chamber relative to the ~~second~~ third radiation source, wherein the at least one second detector of the second channel receives the modulated beam of radiation from the ~~second~~ third radiation source after passage through the sample chamber and substance to be measured therein, and generates a second modulated output signal indicative of the intensity of the radiation of the beam impinging thereon.

8. (currently amended) A device as recited in Claim 7, further comprising an optical longpass filter positioned in front of the ~~second~~ at least one detector of the second channel for separating a fluorescence emission intensity from scattered intensities of the at least one ~~first~~ radiation source of the first channel and for reducing stray light.

9. (currently amended) A device as recited in Claim 1, ~~further comprising a plurality of first radiation sources, each first radiation source emitting a principle ray wherein the principle rays of the first radiation source and the principle ray of the second radiation source each extend~~ through the axis onto a central region of the first detector.

10. (currently amended) A device as recited in Claim 1, wherein the ~~at least one first and second~~ radiation sources is each comprise a light emitting diode.

11. (currently amended) An instrument for measuring characteristics of a substance comprising: A device as recited in Claim 1, wherein

(a) a sample chamber for receiving therein a sample of the substance and defining an axis, the at least one translucent wall defining the sample chamber having ~~comprises~~ at least one optically refractive wall; and

(b) a signal generator including at least one radiation source mounted adjacent to the sample chamber for emitting a beam of radiation through the sample chamber, and at least one detector angularly spaced about the axis of the sample chamber relative to the radiation source, wherein the detector receives the beam of radiation after passage through the sample chamber and substance to be measured therein, and generates an output signal indicative of the intensity of the radiation of the beam impinging thereon;

wherein the at least one optically refractive wall has a refractive power adapted to focus said beam of radiation emitted from said ~~at least one first~~ radiation source ~~and said beam of radiation emitted from said second radiation source~~ onto said ~~at least one first~~ detector.

12. (currently amended) An instrument A device as recited in Claim 11, further comprising a vial defining therein the sample chamber and a recess for removably receiving therein the vial.

13. (currently amended) An instrument A device as recited in Claim 11, wherein the sample chamber is defined by a conduit allowing a field sample to flow therethrough, the impurity is dissolved in the free-flowing substance, and the controller is further operative to monitor the concentration of the impurity.

14. (currently amended) An instrument A device as recited in Claim 11, wherein the controller is operative to generate an output signal and the instrument further display comprises a display for receiving the output signal and generating a human readable version of the output signal measurement reading.

15. (currently amended) An instrument A device as recited in Claim 11, wherein the signal generator is modulated at a given frequency, and the signal is thereby modulated to

distinguish the signal from ambient light and other signals modulated at different frequencies
wherein the modulated beam of the first radiation source is modulated at a first modulation
frequency and the modulated beam of the second radiation source is modulated at a second
modulation frequency different than the first modulation frequency.

16. (currently amended) An instrument A device as recited in Claim 15, further comprising at least two signal generators, each defining a separate channel and meridional plane angularly spaced apart about the axis relative to each other wherein the modulated beam of the third radiation source is modulated at a third modulation frequency different than the first modulation frequency and the second modulation frequency.

17. (currently amended) An instrument A device as recited in Claim 1, further comprising:

data including a plurality of reference measurements based upon a plurality of different reference samples, each reference sample having a different concentration of an impurity, and wherein the controller comprises a controller for (i) automatically comparing the output signal from the signal generator first detector to at least a portion of the reference measurements to determine a concentration of the impurity in the sample and (ii) generating an output signal indicative of the concentration.

18. (currently amended) A device for analyzing radiant transmission and scattering of an elongated sample, wherein the elongated sample defines an axis, the device comprising:

a first channel defining a first meridional plane having the axis extending therethrough and including thereon at least one first radiation source mounted adjacent to the sample, the at least one radiation source including a first radiation source for emitting a first beam of radiation through the sample and a second radiation source for emitting a second beam of radiation through the sample, the first radiation source and the second radiation source being axially spaced relative to each other, and at least one first sensor angularly spaced about the axis of the sample relative to the first radiation source for generating a first output signal indicative of the intensity of radiation impinging thereon, the at least one sensor including a first sensor for detecting radiation impinging thereon, the first radiation source being positioned so that a principle ray emitting therefrom substantially passes onto the first sensor, the second radiation source being positioned so that a principle ray emitting therefrom substantially passes onto the first sensor; and

a second channel defining a second meridional plane having the axis extending therethrough and including thereon at least one second radiation source mounted adjacent to the sample, the at least one radiation source of the second channel including a third radiation source for emitting a second third beam of radiation through the sample, and at least one second sensor angularly spaced about the axis of the sample relative to the second third radiation source for generating a second output signal indicative of the intensity of radiation impinging thereon;

~~wherein the at least one first sensor comprises a sensor for detecting radiation that is emitted from the at least one first radiation source and transmitted through the sample and further detecting radiation that is emitted from the at least one second radiation source and scattered through the sample.~~

19. (currently amended) A device as recited in Claim 18, wherein the at least one first radiation source and the second radiation source each includes a plurality of light emitting diode diodes axially spaced relative to each other, and wherein each light emitting diode is positioned so that a principle ray emitting therefrom substantially passes through the axis of the sample and onto the first sensor.

20. (currently amended) A device as recited in Claim 18, wherein the first and second third radiation sources are selected from the group including green, red, yellow, orange, blue and nearinfrared light emitting diodes.

21. (original) A device as recited in Claim 18, wherein the first and second channels are angularly spaced approximately 45° apart.

22. (currently amended) A device as recited in Claim 18, further comprising a third channel defining a third meridional plane extending through the axis and including thereon at least one third radiation source mounted adjacent to the sample, the at least one radiation source of the third channel including a fourth radiation source for emitting a third fourth beam of radiation through the sample, and at least one third sensor angularly spaced about the axis of the sample relative to the third fourth radiation source for generating a third output signal indicative of the intensity of radiation impinging thereon.

23. (original) A device as recited in Claim 18, wherein the second and third channels are angularly spaced approximately 45° apart and the first and third channels are angularly spaced approximately 90° apart.

24. (currently amended) A device as recited in Claim 18, further comprising a fourth channel defining a fourth meridional plane extending through the axis and including thereon at least one fourth radiation source mounted adjacent to the sample, the at least one radiation source of the fourth channel including a fifth radiation source for emitting a fourth fifth beam of radiation through the sample, and at least one fourth sensor angularly spaced about the axis of the sample relative to the fourth fifth radiation source for generating a fourth output signal indicative of the intensity of radiation impinging thereon.

25. (original) A device as recited in Claim 18, wherein the first and fourth channels are angularly spaced approximately 22.5° apart.

26. (original) A device as recited in Claim 18, wherein the axis lies within the first meridional plane.

27. (original) A device as recited in Claim 26, wherein the axis lies within the second meridional plane.

28. (currently amended) An instrument for testing characteristics of a material comprising: A device as recited in Claim 18, wherein the at least one translucent wall comprises a translucent cell for receiving a sample of the material; and

a housing defining an aperture for receiving therein the translucent cell, the housing including:

a first light source mounted within the housing adjacent to the aperture for emitting light at a first modulated frequency;

at least one detector mounted within the housing and spaced angularly relative to the first light source adjacent to the aperture for converting the modulated light of the first light source into an electrical signal after the modulated light of the first light source passes through the translucent cell, wherein the electrical signal is modulated at the first modulated frequency;

wherein the translucent cell defines an optically refractive element necessary adapted to focusing the modulated light of the first light source first beam of radiation on the least one first detector.

29. (currently amended) An instrument A device as recited in Claim 28, wherein the first light radiation source comprises a light source for emitting a cone of light and the

translucent cell defines the only refractory element disposed along a light path between the first light radiation source and the ~~at least one detector~~ first sensor.

30. (currently amended) An instrument A device as recited in Claim 29, further comprising

a controller coupled to the first sensor; and

a display for converting an output of the detector controller into a human readable form.

31. (currently amended) An instrument A device as recited in Claim 28, wherein the first light radiation source is comprises a light emitting diode.

32. (currently amended) An instrument A device as recited in Claim 28, further comprising wherein the controller comprises a controller for automatically comparing the first electrical output signal of the at least one sensor which is indicative of a degree of transmittance to a database of stored values in order to determine a concentration of an impurity based on such comparing.

33. (currently amended) An instrument A device as recited in Claim 28 18, wherein the translucent cell includes a cap removably attachable for sealing the sample within the cell the sensor for detecting radiation further detects radiation that is emitted from the at least one second radiation source and scattered through the sample.

34. (currently amended) An instrument A device as recited in Claim 28, wherein the translucent cell is a conduit for receiving the material therethrough.

35. (currently amended) An instrument A device as recited in Claim 28, further comprising a beam-splitter positioned in front of the light first radiation source for directing a portion of the light to a reference detector first beam of radiation and for indicating an output power of the light first radiation source to thereby monitor performance of the light first radiation source.

36. (currently amended) An instrument A device as recited in Claim 28, further comprising an amplifier operatively associated with the detector first sensor for boosting the electrical first output signal of the at least one sensor.

37. (currently amended) An instrument A device as recited in Claim 28, further comprising an oscillator operatively associated with the light first radiation source for modulating the light first light beam of the light first radiation source at the a first modulated frequency.

38. (currently amended) An instrument A device as recited in Claim 28, further comprising a reagent contained within the translucent cell for mixing with the material and creating particles which scatter the light.

39. (currently amended) An instrument A device as recited in Claim 28, further comprising a reagent contained within the translucent cell for mixing with the material and creating fluorescence.

40. (currently amended) An instrument A device as recited in Claim 28, further comprising a reagent contained within the translucent cell for mixing with the material and creating an optical absorption band which reduces a transmissivity of the material.

41. (currently amended) An instrument A device as recited in Claim 28, further comprising a controller operatively coupled to the light first radiation source and detector first sensor, and wherein the translucent cell includes an electrical circuit mounted thereon and operatively associated with the controller to provide instructions for testing a material.

42. (currently amended) An instrument A device as recited in claim 28, wherein the translucent cell includes a cap attachable thereto for sealing the sample within the cell.

43. (currently amended) A device for optically measuring qualities of a substance in ambient light comprising:

first means defining a sample chamber for receiving therein the substance to be measured and defining an axis;

a first channel defining a first meridional plane and including thereon:

second means mounted adjacent to the sample chamber for emitting a modulated beam of radiation distinguishable from the ambient light based on said modulation;

third means mounted adjacent to the sample chamber for emitting a modulated beam of radiation distinguishable from the ambient light and the modulated beam of the second means based on said modulation, the second means and the third means being axially spaced relative to each other;

fourth means angularly spaced about the axis of the sample chamber relative to the second means for receiving the modulated beam of radiation of the second means after passage through the sample chamber and substance to be measured therein, and for generating a modulated output signal indicative of the intensity of the radiation of the beam impinging thereon, wherein the fourth means includes a first detector for detecting radiation, the second

means is positioned so that a principle ray emitting therefrom substantially passes onto the first detector, and the third means is positioned so that a principle ray emitting therefrom substantially passes onto the first detector;

a second channel defining a second meridional plane and including thereon fifth means mounted adjacent to the sample chamber for emitting a modulated beam of radiation; and

fifth sixth means coupled to the second and fourth means for activating the second means and processing the output signal.

44. (currently amended) An instrument A device as recited in Claim 43, wherein the second means is a radiation source.

45. (currently amended) An instrument A device as recited in Claim 44, wherein the radiation source is a light emitting diode and an oscillator connected thereto.

46. (currently amended) An instrument A device as recited in Claim 43, wherein the fourth means is a sensor.

47. (currently amended) An instrument A device as recited in Claim 43, wherein the fifth sixth means is a microprocessor and memory operatively connected to the second and fourth means.

48. (currently amended) A method for optically measuring qualities of a substance in ambient light comprising the steps of:

providing a sample chamber defining an axis for receiving therein the substance to be measured;

providing a first channel defining a first meridional plane and including thereon at least two radiation sources mounted adjacent to the sample chamber and at least one detector angularly spaced about the axis of the sample relative to the first radiation source for generating a first output signal indicative of the intensity of radiation impinging thereon, the at least two radiation sources including a first radiation source and a second radiation source, the at least one detector including a first detector, the first and second radiation sources being axially spaced relative to each other, the first radiation source being positioned so that a principle ray emitting therefrom substantially passes onto first detector, the second radiation source being positioned so that a principle ray emitting therefrom substantially passes onto the first detector;

emitting modulated beams of radiation from the first and second radiation sources, each of the first and second radiation sources being modulated at a different frequency and, therefore, distinguishable from the ambient light and each other based on said modulation;

providing a second channel defining a second meridional plane and including thereon at least one radiation source mounted adjacent to the sample chamber and at least one first detector angularly-spaced about the axis of the sample chamber relative to the first at least one radiation source;

receiving the modulated beams of radiation by the first detector after passage through the sample chamber and substance to be measured therein;

generating a modulated output signal indicative of the intensity of the radiation of the modulated beams impinging on the first detector;

activating by a controller the first radiation source and the first detector;

processing the modulated output signal; and

providing a display for providing measurement readings based on the modulated output signal.

49. (original) A method according to Claim 48, wherein any angle effects are automatically taken into account by storing a data point based upon a calibration with a pure water sample.

50. (original) A method according to Claim 49, further comprising the step of dampening any signal at the frequency of ambient light.

51. (currently amended) ~~An instrument for determining a concentration of an impurity within a sample, A device as recited in Claim 18, further comprising:~~

(a) a housing defining a recess for receiving a sample chamber that has at least one memory and is adapted to receive the sample; and

(b) ~~a source operatively connected to the housing for emitting optical energy through the sample;~~

(c) ~~a detector operatively associated with the housing for receiving the optical energy; and~~

(d) ~~at least one processor to communicate with the at least one memory.~~

52. (currently amended) ~~An instrument A device as recited in Claim 51, wherein the first radiation source is a light emitting diode.~~

53. (currently amended) An instrument A device as recited in Claim 51, wherein the detector first sensor is a photovoltaic detector.

54. (currently amended) An instrument A device as recited in Claim 51, further comprising:

at least one oscillator within the housing and operatively connected to the first radiation source; and

a power cell within the housing for driving the at least one oscillator;

~~a second source operatively connected to the housing for emitting optical energy through the sample; and~~

~~a second detector operatively associated with the housing for receiving optical energy, wherein the light sources and detectors lie on fixed axes and meridional planes passing through an axis of the sample.~~

55. (currently amended) An instrument A device as recited in Claim 54, further comprising said sample chamber and wherein said sample chamber further includes a base having a printed circuit board that supports the at least one memory.

56. (currently amended) An instrument for measuring characteristics of a substance comprising: A device as recited in Claim 43, wherein

- (a) ~~first means for defining a the sample chamber comprises a removable sample chamber for receiving therein a sample of the substance and defining an axis, said removable sample chamber having at least one memory; and~~
- (b) ~~second means mounted adjacent to the sample chamber for emitting a beam of radiation through the sample chamber and generating an output signal indicative of the intensity of the beam of radiation after passage through the sample; and~~
- (c) ~~third the device further comprises seventh means in communication with the at least one memory of the first means and in further communication with the second fourth means, for receiving a signal from the second fourth means based upon a sample within the first means.~~

57. (currently amended) An instrument as recited in Claim 56, wherein the first means is comprises a vial.

58. (currently amended) An instrument A device as recited in Claim 56, wherein the second means is comprises a light emitting diode and the first detector comprises a photovoltaic detector.

59. (currently amended) An instrument A device as recited in Claim 56, wherein the third means is at least one memory comprises random access memory and read only memory.

60. (currently amended) An instrument A device as recited in Claim 56, wherein the fourth seventh means is comprises a microprocessor and a software program stored on the third means.

61. (currently amended) An instrument for analyzing color and scattering of a sample, wherein the sample defines an axis, the instrument comprising:

first means for defining a first meridional plane and including thereon second means for emitting a beam of radiation modulated at a first frequency, the second means mounted adjacent to the sample for emitting said beam of radiation through the sample, third means for emitting a beam of radiation modulated at a second frequency that is different than the first frequency, the third means mounted adjacent to the sample for emitting said beam of radiation through the sample, the second means and the third means being axially spaced relative to each other, and third fourth means for sensing angularly spaced about the axis of the sample relative to the second means and including a detector for sensing radiation, the second means being positioned so that a principle ray emitting therefrom substantially passes onto the detector, the third means being positioned so that a principle ray emitting therefrom substantially passes onto detector, the third fourth means generating a first output signal indicative of the intensity of radiation impinging thereon;

fourth fifth means for defining a second meridional plane and including thereon fifth sixth means for emitting a beam of radiation modulated at a second frequency that is different than the first frequency, the fifth sixth means mounted adjacent to the sample for emitting said beam of radiation through the sample, and sixth seventh means for sensing angularly spaced about the axis of the sample relative to the fifth sixth means for generating a second output signal indicative of the intensity of radiation impinging thereon; and

seventh eighth means for activating the first and fourth fifth means and processing said output signals generated thereby.

62. (currently amended) An instrument as recited in Claim 61, wherein the ~~seventh~~
~~eighth~~ means activates the second and ~~fifth~~ ~~sixth~~ means simultaneously and corresponding
signals generated thereby are distinguishable.